CLAIMS

What is Claimed is:

1. A method for making a molecular electronic device comprising the steps of:

providing a substrate comprising a surface on which is located a first electrode pattern;

depositing molecules having an electrical characteristic onto said substrate surface to form a molecular layer which covers said substrate surface including said first electrode pattern;

depositing an electrically conductive material onto said molecular switching layer to form an electrically conductive protective layer having an exposed surface;

forming a second electrode pattern on the exposed surface of said protective layer wherein said second electrode pattern overlaps said first electrode pattern to form at least one electrode intersection; and

removing said protective layer at locations which remain exposed after formation of said second electrode pattern to form at least one electrode intersection wherein said molecular layer and electrically conductive protective layer are sandwiched between said first and second electrodes.

2. A method for making a molecular electronic device according to claim **1** wherein said electrical characteristic of said molecules is bistable switching.

3 A method for making a molecular electronic device according to claim **1** wherein said step of forming said second electrode pattern on the exposed surface of said electrically conductive protective layer comprises the steps of:

forming a mask layer covering said electrically conductive protective layer;

removing a sufficient portion of said mask layer to form an electrode location on said electrically conductive protective layer; and

depositing electrode material onto said electrode location to form said second electrode pattern on said protective layer.

4. A method for making a molecular electronic device according to claim **1** wherein said molecule is a bistable switching molecule or a molecule exhibiting differential resistance selected from the group consisting of [2]rotoxanes, [2]catenanes, spiropyrans, and [2]pseudorotaxanes.

5. A method for making a molecular electronic device according to claim **1** wherein said electrically conductive material which is used to form said protective layer is selected from the group of metals consisting of titanium and chromium.

6. A method for making a molecular electronic device according to claim **1** wherein said molecular layer is a Langmuir monomolecular layer.

7. A method for making a molecular electronic device according to claim **1** wherein said first and second electrode patterns are made from a metal selected from the group consisting of aluminum, gold, silver, cobalt, iron, nickel, tin, copper, platinum, palladium, and alloys thereof.

8. A method for making a molecular electronic device according to claim **1** wherein said first and second electrode patterns are made from a material selected from the group consisting of silicon, polysilicon, amorphous silicon, gallium arsenide and electrically conducting doped polymers.

9. A method for making a molecular electronic device according to claim **1** wherein said device comprises molecular switch tunnel junctions, molecular switch cross-point memories, molecular switch logic circuits or molecular-based resonant tunnel diodes which exhibit negative differential resistance.

10. A method for making a molecular electronic device according to claim **1** wherein said electrically conductive protective layer is removed by either wet etching or dry etching.

11. A method for making a molecular electronic device according to claim **1** wherein said second electrode pattern is formed using either electron or photon lithography.

12. A method for making a molecular electronic device according to claim **1** wherein said second electrode pattern is formed via either a stamping or imprinting technique.

13. An assembly for use in making a molecular electronic device, said assembly comprising:

a substrate comprising a surface on which is located a first electrode pattern;

a layer of molecules having an electrical characteristic which has been deposited onto said substrate surface to form a molecular layer which covers said substrate surface including said first electrode pattern;

a layer of electrically conductive material which has been deposited onto said molecular layer to form an electrically conductive protective layer having an exposed surface on which a second electrode pattern may be formed.

14. An assembly in accordance with claim **13** for use in making a molecular electronic device, said assembly further comprising a second electrode pattern which has been formed on said electrically conductive protective layer wherein said second electrode pattern overlaps said first electrode pattern to form at least one electrode intersection.

15. An assembly in accordance with claim **13** for use in making a molecular electronic device wherein said substrate comprises a material selected from the group consisting of an organic polymer, silicon, germanium, gallium arsenide, silicon dioxide, or sapphire.

16. An assembly in accordance with claim **13** for use in making a molecular electronic device wherein said molecular layer comprises bistable switching molecules selected from the group consisting of rotoxanes, catenanes, and pseudorotaxanes.

17. An assembly in accordance with claim **13** for use in making a molecular electronic device wherein said electrically conductive material which is used to form said protective layer is selected from the group of metals consisting of titanium and chromium.

18. An assembly in accordance with claim **13** for use in making a molecular electronic device wherein said molecular layer is formed as a self-assembled molecular monolayer film or is formed as a Langmuir-Blodgett molecular monolayer or multilayer film or is deposited via vapor sublimination or vapor deposition.

19. An assembly in accordance with claim **13** wherein said first electrode pattern is made from a material selected from the group consisting of aluminum, gold, silver, cobalt, iron, nickel, tin, copper, platinum, palladium and alloys thereof, and silicon, polysilicon, amorphous silicon, gallium arsenide and doped polymers.

20. An assembly in accordance with claim **14** wherein second electrode pattern is made from a material selected from the group consisting of aluminum, gold, silver, cobalt, iron, nickel, tin, copper, platinum, palladium and alloys thereof, and silicon, polysilicon, amorphous silicon, gallium arsenide and doped polymers.

21. A molecular electronic device or circuit comprising:

a. a substrate comprising a surface on which is located a first electrode pattern having an interior surface;

b. a second electrode pattern having an interior surface wherein said second electrode pattern overlaps said first electrode pattern to form at least one electrode intersection located between the interior surfaces of said first and second electrode patterns;

c. a layer of electrically conductive protective material located on the interior surface of said second electrode pattern; and

d. a layer of molecules having an electrical characteristic located adjacent to said layer of electrically conductive material wherein said one or more electrode intersections comprise said molecules and said electrically conductive protective material sandwiched between said first and second electrode patterns.

22. A molecular electronic device according to claim **21** wherein said molecules have the electrical characteristic of bistable switching.

23. A molecular electronic device according to claim **21** wherein said first and second electrode patterns have nanometer scale dimensions.

24. A molecular electronic device or circuit made according to the method of claim **1**.